

SECTION XXVI

CODE OUTPUT OPTION

1 INTRODUCTION

This section describes the operation and features of the Code Output Option.

2 GENERAL DESCRIPTION

The Code Output Option is available with up to four AM Code Outputs and four DC Code Outputs in the following configurations:

1. Four AM Code Outputs via BNC Output 1, 2, 3, & 4, installed in a XL-DC card slot.
2. Two AM Code Outputs via BNC Output 3 & 4, and four Differential DC Code Outputs via DB-9 connector installed in an XL-DC card slot.
3. Four AM Code Outputs via BNC Output 1, 2, 3, & 4, and four Single-ended DC Code Outputs via BNC connectors or four Differential DC Code Outputs via triax connectors, using two XL-DC card slots.
4. Four AM Code Outputs via SMB Output 1, 2, 3, & 4 and four Differential DC Code Outputs via DB-9 connector, installed in a 705 card slot.
5. Any of the above configurations can be optionally equipped with an IRIG-B Input, used as a secondary time-reference.

The Code Output Option allows the user to generate up to four independent timing signals simultaneously. The four signals can be any combination of Time Codes, Frequency References, or Pulse Rates. Each DC Code Output is a buffered version of the Time Code modulation signal for the associated AM Code Output. A menu is provided via the XL-DC LCD Display or RS-232 Port, allowing the user to select from a variety of Time Codes and Reference Frequencies. All Output signals are synchronized to the 1 PPS.

3 OUTPUT CHANNEL SPECIFICATIONS

AM Code Outputs:

Quantity:	1 to 4, depending upon configuration
Connector:	Female SMB (Model 705) / Female BNC (Model XL-DC)
Output impedance:	25 Ω
Amplitude into 50 Ω :	0-3 Vp-p, adjustable via internally-accessible potentiometer
Amplitude into 600 Ω :	0-10 Vp-p, adjustable via internally-accessible potentiometer
Modulation Ratio:	2:1 through 5:1, adjustable via internally-accessible potentiometer
Accuracy:	Synchronized to 1 PPS to within 0.5% of AM Code period
Time Codes:	IRIG-A 130 IRIG-A 133 IRIG-B 120 IRIG-B 123 IRIG-E 111 IRIG-E 112 IRIG-E 121 IRIG-E 122 IRIG-G 141 IRIG-G 142 IRIG-H 111 IRIG-H 112 IRIG-H 121 IRIG-H 122 2137 XR-3 NASA-36 (All codes in 24 hour format)
References:	100 kHz, 10 kHz, 1 kHz, 250 Hz, and 100 Hz unmodulated sine wave (Associated DC Code Output = 0 - 5 VDC)
Time References:	Standard, UTC, GPS or Local

Note: 1 kPPS, 100 PPS, 10 PPS, and 1 PPS are displayed but not available.

DC Code Outputs, Single-Ended (Option):

Quantity: 1 to 4, depending upon configuration
Accuracy: Synchronized to 1 PPS to within 100 ns
Connector: Female BNC
Output Impedance: 25 Ω
Output Level(+Out): Logic 0 \leq 0.5 V / Logic 1 \geq 2.5 V referenced to GND, into 50 Ω
Time Codes: IRIG-A 000 IRIG-A 003 IRIG-B 000 IRIG-B 003
IRIG-E 001 IRIG-E 002 IRIG-G 001 IRIG-G 002
IRIG-H 001 IRIG-H 002 2137 XR-3
NASA-36 (All codes in 24 hour format)
Pulse Rates: 1 kPPS, 100 PPS, 10 PPS, 1 PPS @ 50 % Duty Cycle TTL via DC Code Output.

DC Code Outputs, Differential (Option):

Quantity: 4
Accuracy: Synchronized to 1 PPS to within 100 ns
DB-9 Connector: DB-9F - 9-position D-subminiature, female
1 DC Code 1 - Out 6 DC Code 1 + Out
2 DC Code 2 - Out 7 DC Code 2 + Out
3 DC Code 3 - Out 8 DC Code 3 + Out
4 DC Code 4 - Out 9 DC Code 4 + Out
5 DC Code Return (GND)
Triax Connector: Triax, female
Center +Out Inner -Out Outer GND
Output Impedance: 25 Ω
Output Level(+Out): Logic 0 \leq 0.5 V / Logic 1 \geq 2.5 V referenced to GND, into 50 Ω
Output Level(-Out): Logic 0 \leq 0.5 V / Logic 1 \geq 2.5 V referenced to GND, into 100 Ω
Differential mode is RS-422 compatible
Time Codes: IRIG-A 000 IRIG-A 003 IRIG-B 000 IRIG-B 003
IRIG-E 001 IRIG-E 002 IRIG-G 001 IRIG-G 002
IRIG-H 001 IRIG-H 002 2137 XR-3
NASA-36 (All codes in 24 hour format)
Pulse Rates: 1 kPPS, 100 PPS, 10 PPS, 1 PPS @ 50 % Duty Cycle TTL via DC Code Output.

4 IRIG-B (AM) SYNC GENERATOR INPUT SPECIFICATIONS (OPTION)

Connector: Female SMB (Model 705) / Female BNC (Model XL-DC)
Input Impedance: 8 k Ω
Input Amplitude: 0.5 Vp-p to 10 Vp-p
Input Ratio: 2:1 to 5:1 / Adjustable, Factory default is 3:1

Note: The IRIG-B Sync Generator Input for the Model XL-DC or Model 705 is assumed LOCAL time. If the unit is set to either GPS, UTC, or Standard Time Mode, the unit will calculate a time offset dependent upon the current Time Zone, Leap Seconds offset, and whether DST is active or not.

The IRIG-B Sync Generator derives its time from an amplitude-modulated IRIG-B time code input and phase adjusts the GPS-XL time base to the input code. If the input code should fail, the receiver will continue to update its time using the internal or external (OPTION) oscillator.

5 INSTALLATION

No installation is required when this option is purchased with the Model 705 or XL-DC. This option is not available for field installation in the Model 705. The following installation instructions apply only to installation after the initial purchase of a Model XL-DC.

6 FIELD INSTALLATION

The following items are supplied with the Code Output Option:

- Code Output Option Card.
- Mounting hardware.
- Replacement Instructions (and EPROM if required).

Warning: Only a qualified technician should attempt installation of this option. Dangerous voltages are present which can cause electric shock that could result in severe injury or even death. Disconnect all power before disassembling the unit!

The only equipment required for installation is a Phillips screwdriver and an EPROM extraction tool. Unless otherwise specified at order time, the AM output level is set for 3 Vp-p (1 V RMS) into 50 Ω and the modulation ratio is set at 3:1. If the output level or modulation ratio are to be changed, a potentiometer adjusting tool will also be required.

1. If the receiver is rack mounted, first remove it from the rack. Installation requires inserting the Code Output Option Card Assembly into an empty option slot.
2. Remove the top lid and retain the screws. Remove the cover plate of an empty option slot and save the screws. (It is preferable to place the Code Output Option in a top slot so that the Output level and modulation ratio adjustments are accessible.) Slide the option assembly into the guides on the side rails of the slot and firmly press the assembly connector into the Bus Backplane Assembly connector. Secure the option to the chassis with the previously saved screws. Install the new EPROM as described in the EPROM Replacement Instructions sent with the option.
3. Four position DIP switch SW2 selects the Port Number (0 through 15) of the Code Output Option Card or any other TrueTime "SmartCard". Each "SmartCard" option is automatically identified when the unit is turned on. In XL-DC applications where multiple "Smart Card" options are installed, each option card requires a different Port Number (the specific Port Number of any particular option card is not important). The Port Number is normally set at the factory and is only of concern when a field installation is performed.

In situations where a particular Port Number is desired, it can be set into the DIP switch as follows:

SW2-4	SW2-3	SW2-2	SW2-1	Port	SW2-4	SW2-3	SW2-2	SW2-1	Port
OFF	OFF	OFF	OFF	0	ON	OFF	OFF	OFF	8
OFF	OFF	OFF	ON	1	ON	OFF	OFF	ON	9
OFF	OFF	ON	OFF	2	ON	OFF	ON	OFF	10
OFF	OFF	ON	ON	3	ON	OFF	ON	ON	11
OFF	ON	OFF	OFF	4	ON	ON	OFF	OFF	12
OFF	ON	OFF	ON	5	ON	ON	OFF	ON	13
OFF	ON	ON	OFF	6	ON	ON	ON	OFF	14
OFF	ON	ON	ON	7	ON	ON	ON	ON	15

4. The AM Output signal levels and modulation ratios are adjustable via potentiometers labeled LEVEL 1 through 4 and RATIO 1 through 4. These are typically adjusted at the factory. If adjustment is required, it must be performed with the lid removed and with the operational-load connected to the associated output. After adjustment, replace the lid and secure with the previously saved screws.

7 OPERATION

Time Code Output

The Code Output Option Card generates four independent Time Codes, Pulse Rates, or Frequency References. The type of Timing Signal generated at each Output is selected via the front panel keypad or the RS-232 port on XL-DC products. Selection is made only via the RS-232 port on 705 products. The new setup is automatically saved in non-volatile memory. (See INSTALLATION Section for adjustment of AM Output signal level and modulation ratio.)

RS-232 Setup

Each Output of the Code Output Option is setup individually via the RS-232 port using Function 42. Use the following ASCII string (upper or lower-case characters) to select the current Timing Signal being generated at each Output:

```
F42<SEP>O<SEP><N><SEP><T><ADDRESS><LT>
```

Use the following ASCII string to display the current setup of each Output 1 through 4:

```
F42<SEP>O<SEP><N><LT>
```

The RS-232 port responds with the following ASCII string:

```
<T>, <SEP><DESC><ADDRESS><LT>
```

Where:

F42	= string representing the Function Number.
<SEP>	= one or more space characters.
O	= the letter "O" (representing "Output").
<N>	= Number 1-4, selecting which output port (1-4) to be setup.
<T>	= Timing Signal Type:
	A B120 B123 E111 E112 E121 E122 G
	H111 H112 H121 H122 2137 XR3 N36 100k
	10k 1k 250 100 P1k P100 P10 P1
	Off (See Section 9-1 for Timing Signal Type description)
<DESC>	= Description of the type.
<ADDRESS>	= Address #
<LT>	= Line Terminator, a Carriage Return and Line Feed for output strings or a Carriage Return for input strings.

Sample request: F42 O 1<CR>
Response: H122, IRIG-H 1K<CR><LF>

Sample Input: F42 O 3 100<CR>
Response: OK<CR><LF>

Sample Request: F42 O 3<CR>
Response: 100, 100 Hz SINE<CR><LF>

Use the following ASCII string (upper or lower-case characters) to select the type of IRIG-A or G signal to be generated (All outputs provide identical type.):

```
F42<SEP>I<SEP><T><SEP><Nbr><LT>
```

Use the following ASCII string to display the current setup of each Output 1 through 4:

```
F42<SEP>I<SEP><T><LT>
```

The RS-232 port responds with the following ASCII string:

```
<T><Nbr><LT>
```

Where:

F42	= string representing the Function Number
<SEP>	= one or more space characters
I	= the letter "I" (representing "IRIG")
<N>	= Number 1-4, selecting Output to be setup
<T>	= IRIG Type: "A" or "G"
<Nbr>	= IRIG Number: "130" or "133" for IRIG-A; "141" or "142" for IRIG-G
<LT>	= Line Terminator, a Carriage Return and Line Feed for output strings or a Carriage Return for input strings

Sample request: F42 I a<CR>
Response: A130 1k,CF,SBS<CR><LF>

Sample Input: F42 I A 130<CR>
Response: OK<CR><LF>

Use the following ASCII string (upper or lower-case characters) to select the Time Reference for all IRIG signals:

```
F42<SEP>T<SEP><R><ADDRESS><LT>
```

Use the following ASCII string to display the current setup of each Output 1 through 4:

```
F42<SEP>T<ADDRESS><LT>
```

The RS-232 port responds with the following ASCII string:

```
<T><R><LT>
```

Where:

F42	= string representing the Function Number
<SEP>	= one or more space characters
T	= the letter "T" (representing "TIME")
<R>	= Time Reference: "S", "U", "G," or "L" (Standard, UTC, GPS, or Local)
<LT>	= Line Terminator, a Carriage Return and Line Feed for output strings or a Carriage Return for input strings
<ADDRESS>	= Multi board address #

Sample request: F42 T<CR>
Response: Standard<CR><LF>

Sample Input: F42 T U<CR>
Response: OK<CR><LF>

The RS-232 port responds to input syntax errors with the following ASCII string:

```
ERROR 02 SYNTAX<CR><LF>
```

8 XL-DC SETUP

In Brief

Press "FUNCT/ENTR" then "4" "2" to select Function 42 (F42).

Use FUNCT/ENTR to scroll through sub-menus and back to normal XL Status display:
Time Type -> Output 1 -> 2 -> 3 -> 4 -> IRIG-A Type -> IRIG-G Type -> Save Setup?.
(IRIG-A / IRIG-G sub-menus appear only if an Output is set to IRIG-A or IRIG-G.)

First value displayed in each sub-menu is current setting. Use the up or down arrow keys to scroll through possible choices within each sub-menu. Press FUNC/ENTR to select displayed choice and advance to next sub-menu.

At last sub-menu (Save Setup), new settings are implemented and stored in non-volatile memory by selecting Yes. Any new settings are ignored by selecting No. *Press "Status" or "Position" at any time to terminate F42 without changing setup.*

In Detail

On the Model XL-DC, each Output can be setup via Keypad Function 42 (F42). Use F42 to select and display the current Timing Signal being generated at each Output, 1 through 4, of the Code Output Option Card. *Press "Status" or "Position" to terminate F42 without changing setup.*

To display the current setup , press "FUNCT/ENTR" then "4" "2". The display will show:

```
Time Type
<TYPE>
```

Where <TYPE> is the current time type:

```
UTC          Local          Standard      GPS
```

To change current type, press the up or down arrow keys to scroll through possible choices. Press FUNCT/ENTR to select the displayed choice. Display shows:

```
Output #
<TYPE>
```

Where <TYPE> is the current type of timing signal being output:

```
A      B120  B123  E111  E112  E121  E122  G
H111  H112  H121  H122  2137  XR3   N36   100k
10k   1k    250   100   P1k   P100  P10   P1
Off   (See Section 9-1 for Timing Signal Type description)
```

To change current type, press the up or down arrow keys to scroll through possible choices. Press FUNCT/ENTR to select the displayed choice and advance to the next Output. After Output 4, the display shows:

```
IRIG-A Type          (displayed only if IRIG-A was chosen for an Output)
<TYPE>
```

Where <TYPE> is the current IRIG-A type:

```
A130  A133
```

To change current type, press the up or down arrow keys to scroll through possible choices. Press FUNCT/ENTR to select the displayed choice. The display will show:

IRIG-G Type (displayed only if IRIG-G was chosen for an Output)
<TYPE>

Where <TYPE> is the current IRIG-G type:
G141 G142

To change type, press the up or down arrow keys to scroll through possible choices. Press FUNCT/ENTR to select the displayed choice. The display will show:

Save Setup?

No

Press the up or down arrow keys to select Yes/No. Press FUNCT/ENTR to select the displayed choice. Select Yes to implement new settings and save them to non-volatile memory. Select No to ignore any new settings, maintaining current setup. The display will revert to the normal XL Status display.

Note: Selecting IRIG-type A or G applies the time format to all the outputs.

9 AVAILABLE CODES

Each Output Channel is capable of generating the following codes in 24 hour time format. The DC Code is a buffered copy of the AM Code modulation signal.

<u>Selection</u>	<u>AM Code Out</u>	<u>DC Code Output</u>	<u>Coded Expressions</u>
A	IRIG-A 130 10 kHz IRIG-A 133 10 kHz	IRIG-A 000 DC Shift IRIG-A 003 DC Shift	BCD,CF(Quality&Lock),SBS BCD,SBS
B120 B123	IRIG-B 120 1 kHz IRIG-B 123 1 kHz	IRIG-B 000 DC Shift IRIG-B 003 DC Shift	BCD,CF(Quality&Lock),SBS BCD,SBS
E111 E112	IRIG-E 111 100 Hz IRIG-E 112 100 Hz	IRIG-E 001 DC Shift IRIG-E 002 DC Shift	BCD,CF(Quality&Lock) BCD
E121 E122	IRIG-E 121 1 kHz IRIG-E 122 1 kHz	IRIG-E 001 DC Shift IRIG-E 002 DC Shift	BCD,CF(Quality&Lock) BCD
G	IRIG-G 141 100 kHz IRIG-G 142 100 kHz	IRIG-G 001 DC Shift IRIG-G 002 DC Shift	BCD,CF(Quality&Lock) BCD
H111 H112	IRIG-H 111 100 Hz IRIG-H 112 100 Hz	IRIG-H 001 DC Shift IRIG-H 002 DC Shift	BCD,CF(Quality&Lock) BCD
H121 H122	IRIG-H 121 1 kHz IRIG-H 122 1 kHz	IRIG-H 001 DC Shift IRIG-H 002 DC Shift	BCD,CF(Quality&Lock) BCD
2137	2137 1 kHz	2137 DC Shift	
XR3	XR3 250 Hz	XR3 DC Shift	
N36	NASA 36 1 kHz	NASA 36 DC Shift	
100k	Reference 100 kHz		Sine wave Reference
10k	Reference 10 kHz		Sine wave Reference
1k	Reference 1 kHz		Sine wave Reference
250	Reference 250 Hz		Sine wave Reference
100	Reference 100 Hz		Sine wave Reference
*P1k		1 kPPS DC Shift	TTL Pulse, 50% Duty Cycle
*P100		100 PPS DC Shift	TTL Pulse, 50% Duty Cycle
*P10		10 PPS DC Shift	TTL Pulse, 50% Duty Cycle
*P1		1 PPS DC Shift	TTL Pulse, 50% Duty Cycle
Off		0 VDC	

Where:

CF	Condition Flags. Includes Time Quality and Lock Flags.
BCD	Binary Coded Decimal.
SBS	Straight Binary Seconds.

***Note:** 1 kPPS, 100 PPS, 10 PPS, and 1 PPS are displayed but not available.

Condition flag are embedded in the IRIG codes, with the CF option. These flags are the Lock and Time Quality indicators. IRIG-B and IRIG-E condition flags are described in section 8 of the manual.

The following table describes the position of condition codes in the IRIG output.

<u>IRIG-Type</u>	<u>Lock Flag</u>	<u>Time Quality 1</u>	<u>Time Quality 2</u>	<u>Time Quality 3</u>	<u>Time Quality 4</u>
IRIG-A	P5 + 4ms	P5 + 6ms	P5 + 7ms	P5 + 8ms	P5 + 9ms
IRIG-B	P5 + 40ms	P5 + 60ms	P5 + 70ms	P5 + 80ms	P5 + 90ms
IRIG-E	P5 + 0.4sec	P5 + 0.6sec	P5 + 0.7sec	P5 + 0.8sec	P5 + 0.9sec
IRIG-G	P6 + 0.4ms	P6 + 0.6ms	P6 + 0.7ms	P6 + 0.8ms	P6 + 0.9ms
IRIG-H	P5 + 4sec	P5 + 6sec	P5 + 7sec	P5 + 8sec	P5 + 9sec

Where:

p5	Position Identifier 5 of the IRIG frame.
ms	Milliseconds.
sec	Seconds.

10 IRIG-B (AM) SYNC GENERATOR INPUT (OPTION)

An IRIG-B signal input via the optional connector is automatically detected. The input Sync Gen signal becomes the timing reference for the XL-DC or 705.

Note: The Multicode card with IRIG-B synch won't lock to IRIG-B unless one of the outputs of the Multicode card is set to IRIG-B.

11 THEORY OF OPERATION

The GPS-XL Processor Assembly 87-6XX and the 87-6002-X Assembly implement the Code Output Option.

Code Output

Refer to the 86-6002 schematic in this manual section. The 87-6XX GPS-XL Assembly initializes the 87-6002-X Code Output Option Assembly at power-on through a Field Programmable Gate Array (FPGA) U12. U12 is the interface between the GPS-XL processor and the on board 68HC11 "Smart Card" processor (HC11) U1. The HC11 on-board processor and FPGA provide the timing and control signals for the four Output channels. The following describes Output channel 1; the other channels operate similarly.

Besides supporting communication with the 87-6XX GPS-XL Assembly, FPGA U12 generates the five carriers for the AM Code outputs: 100 kHz, 10 kHz, 1 kHz, 250 Hz, and 100 Hz. A 100-step digital sine wave is synthesized by transferring 8-bit values from a look-up table inside the FPGA to five D-to-A converters (DACs) U26, U28, U29, U31, and U33. Each DAC continuously generates one of the five carrier frequencies via op amps U27, U30, and U32, configured as current-to-voltage converters. The analog sine wave is fed into the 5:1 multiplexer U8 via a RC filter, which removes the digital steps. The multiplexer selects which frequency will drive the Output channel. The multiplexer is controlled by a register inside the FPGA, which is loaded by the HC11 according to the current Output Card setup stored in HC11-resident non-volatile memory. The carrier is fed to the modulator via U9, which isolates it from the filter.

The modulator consists of a potentiometer R91 and an analog switch U10. R91 sets the level of the low (SPACE) portion of the modulated carrier. The high (MARK) portion is always full amplitude. The analog switch selects the MARK amplitude or the SPACE amplitude, on a cycle by cycle basis, under control of the modulation signal provided by the FPGA. The modulation signal is controlled by the HC11, which writes modulation data to registers inside the FPGA. The 100 kHz and 10 kHz modulation signals come from shift registers loaded by the HC11. The 1 kHz and slower signals are output by the HC11 on a cycle by cycle basis, updated every millisecond and output on the millisecond. The modulation signal is fed to 74AC240/74AC244 drivers U22 and U25, which provide the DC Code output signals. The modulated

carrier is fed to U9, which amplifies the signal and feeds it through level control pot R90 to the AM Code driver U34.

The on-time edge of each output is synchronized to the 705/XL-DC time-base. This is implemented by using the 10 MHz system clock to generate all FPGA internal clocks and using the system 1 PPS to synchronize the sine wave generator and modulation-control signals. Additionally, the timing of each of the 5 sine waves is controlled to account for phase-delay through the filter, such that the sine wave zero-crossing is synchronized to the modulation signal at the modulator.

IRIG-B Sync Generator (Option)

An IRIG-B source is connected to the 86-6002 board via J1. J1 connects to op-amp U4A. This op-amp, and associated support components, implements an AGC circuit. The AGC allows operation of the sync generator if the IRIG-B input signal is between 0.5 to 10 volts peak to peak.

The output from the AGC (U4B) is connected to voltage comparators U2 and U3. U3 produces the signal MK and U2 produces the signal CAR. Both of these signals are connected to FPGA U12, which produces the signal DCCODE, which is connected to the local HC11 processor, where it is used as a source for the synchronized generator. A multiplexer, located inside the FPGA, allows the HC11 to automatically take external IRIG-B from either a single-ended AM source or a complementary RS-422 source. The IRIG-B input can be factory-configured for either.

The HC11 processor reads the incoming code (DCCODE) and communicates the IRIG-B time through FPGA to the GPS-XL processor assembly, the master clock. The GPS-XL processor uses the IRIG-B source to phase adjust its time base to the input IRIG-B code. When the IRIG-B source is connected to the unit, and the GPS-XL processor assembly determines that the code is valid, the GPS-XL will use the incoming code to synchronize and change the time in the unit - even if the GPS-XL is tracking and locked to satellites.

If the input code should fail, the receiver will continue to update its time using the internal or external (OPTION) oscillator. The Time Quality Flags and Lock Indicator will be based upon the previous IRIG-disciplined oscillator characteristics until the clock synchronizes back to GPS disciplining.

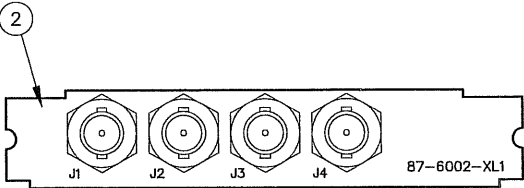
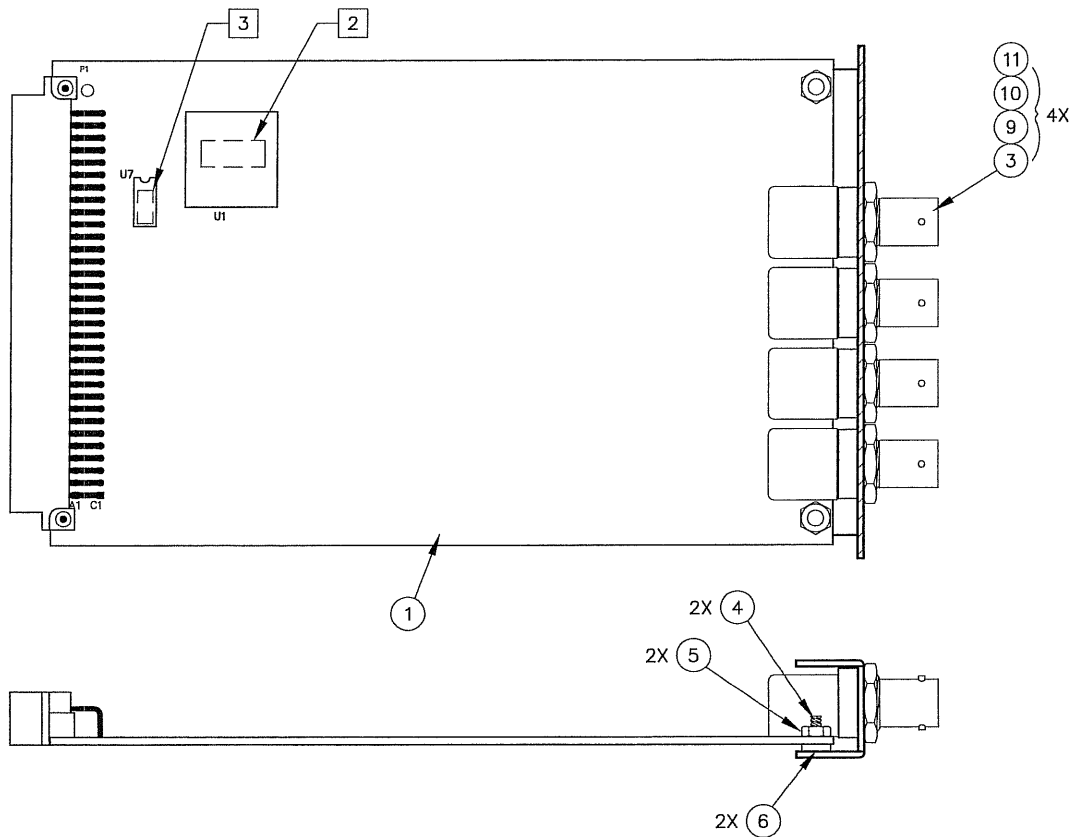
12 MAINTENANCE AND TROUBLESHOOTING

This option has been designed to provide maintenance-free operation. Under normal use, it will require no calibration or adjustment. Before assuming a malfunction, first be certain that the unit using the Code Output Option is functioning properly. Verify that all connectors are secure and that coax cables are good. If all but the 87-6002-X Code Output Option Assembly appears to be operating properly, please contact a TrueTime Customer Service Representative.

Note: The Multicode card with IRIG-B synch won't lock to IRIG-B unless one of the outputs of the Multicode card is set to IRIG-B.

© TrueTime, Inc 2002 PROPRIETARY NOTICE
 THIS DOCUMENT, WHETHER PATENTABLE OR NON-PATENTABLE SUBJECT MATTER, EMBODIES PROPRIETARY AND CONFIDENTIAL INFORMATION AND IS THE EXCLUSIVE PROPERTY OF TRUETIME, INC. IT MAY NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS FOR ANY PURPOSE EXCEPT THAT FOR WHICH IT IS LOANED, AND IT SHALL BE RETURNED UPON DEMAND.


REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	DELETE ITEM 8	10-28-97	DR
B	ECO 1653	04/04/02	MDK
C	ECO 1724	04/10/02	RWK
D	ECO 1819; XLI PRODUCTION RELEASE	08/30/02	ex/DR



- 3 ADD LABEL WITH DEVICE PROGRAM # 184-028.
- 2 ADD LABEL WITH DEVICE PROGRAM # 182-5007.
- 1. ASSEMBLE PER ASSEMBLY REQUIREMENTS DOCUMENT 421-11.

NOTES: UNLESS OTHERWISE SPECIFIED

FILENAME: 87-6002-XL1
 DATE: 08-30-02

CONTRACT NO.					
APPROVALS	DATE				
DRAWN BY SEIFERT	3/96				
CHECKED BY		ASSEMBLY, MULTICODE 4 AM OUTPUTS			
APPROVED BY DR/DL	10/97				
NEXT ASSY		SIZE	CODE IDENT NO.	DRAWING NO.	REV
		B		87-6002-XL1	D
		SCALE NONE		SHEET 1 OF 1	

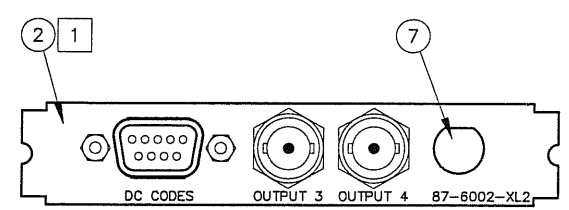
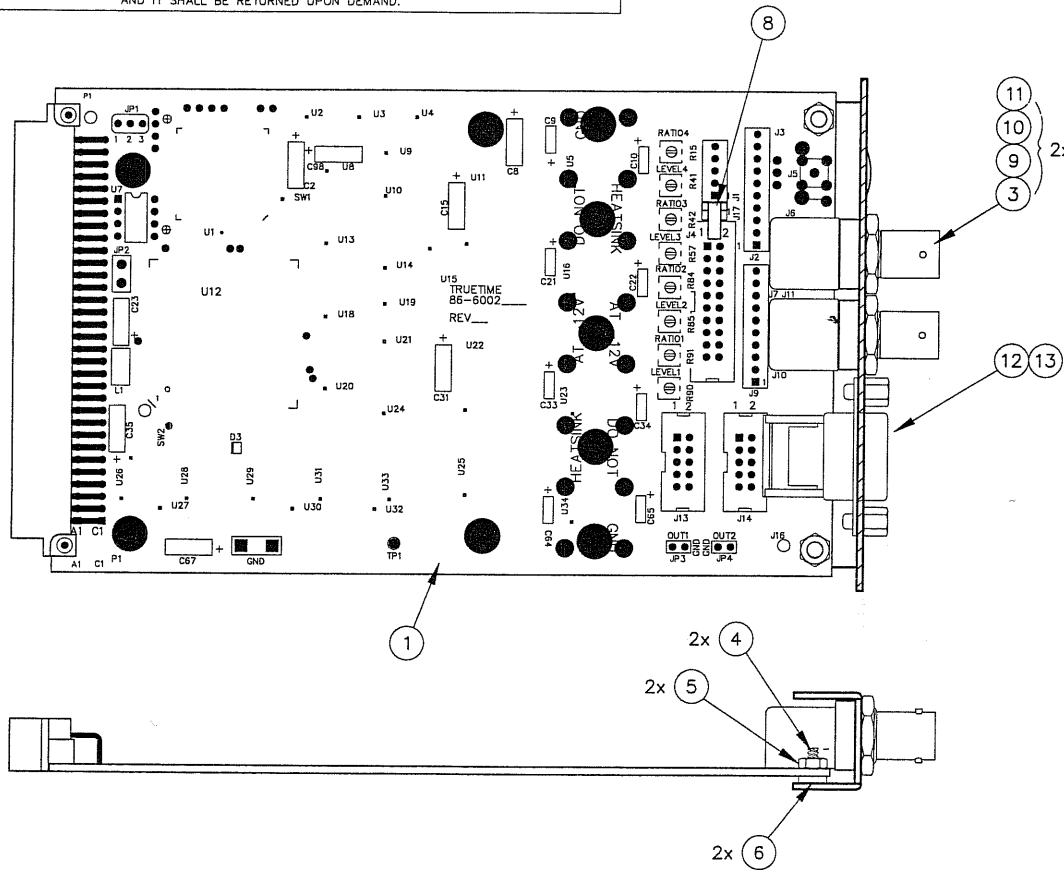
© TrueTime, Inc. 1998 All Rights Reserved.

PROPRIETARY NOTICE

THIS DOCUMENT, WHETHER PATENTABLE OR NON-PATENTABLE SUBJECT MATTER, EMBODIES PROPRIETARY AND CONFIDENTIAL INFORMATION AND IS THE EXCLUSIVE PROPERTY OF TRUETIME, INC. IT MAY NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS FOR ANY PURPOSE EXCEPT THAT FOR WHICH IT IS LOANED, AND IT SHALL BE RETURNED UPON DEMAND.

REVISIONS

REV	DESCRIPTION	DATE	APPROVED
A	CAR 1050	09/03/98	



1. LABEL PANEL AS SHOWN.

NOTES: UNLESS OTHERWISE SPECIFIED.

FILENAME: \87\6002-XL2
DATE: 09-03-98

CONTRACT NO.		 <small>"Where Customer Satisfaction is our Highest Priority"</small> 2835 Duke Ct. Santa Rosa, CA 95407				
APPROVALS	DATE				ASSEMBLY, XL 4AM OUTPUTS	
DRAWN BY KOLLANDER	9/97					
CHECKED BY						
APPROVED BY <i>Doc</i>	9/98					
NEXT ASSY	SIZE	CODE IDENT NO.	DRAWING NO.	REV		
	B		87-6002-XL2	A		
SCALE NONE		SHEET 1 OF 1				

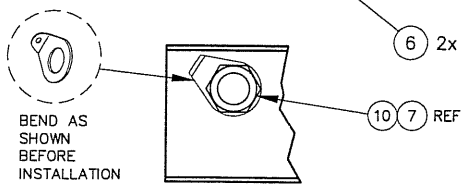
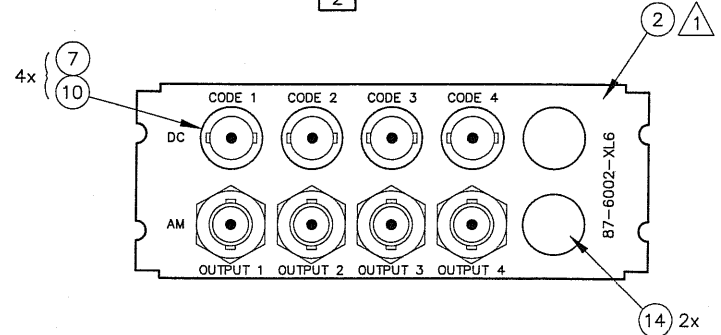
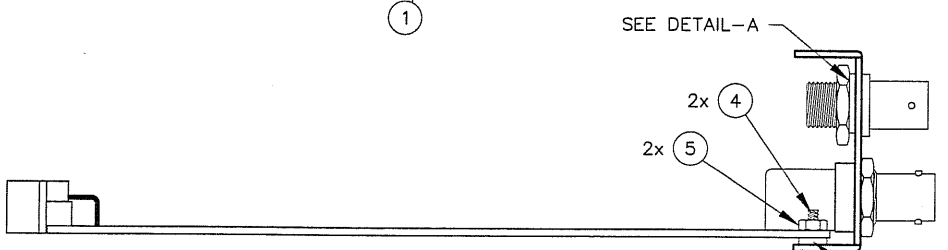
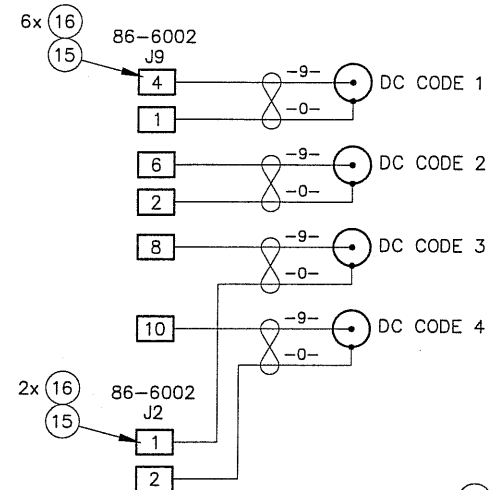
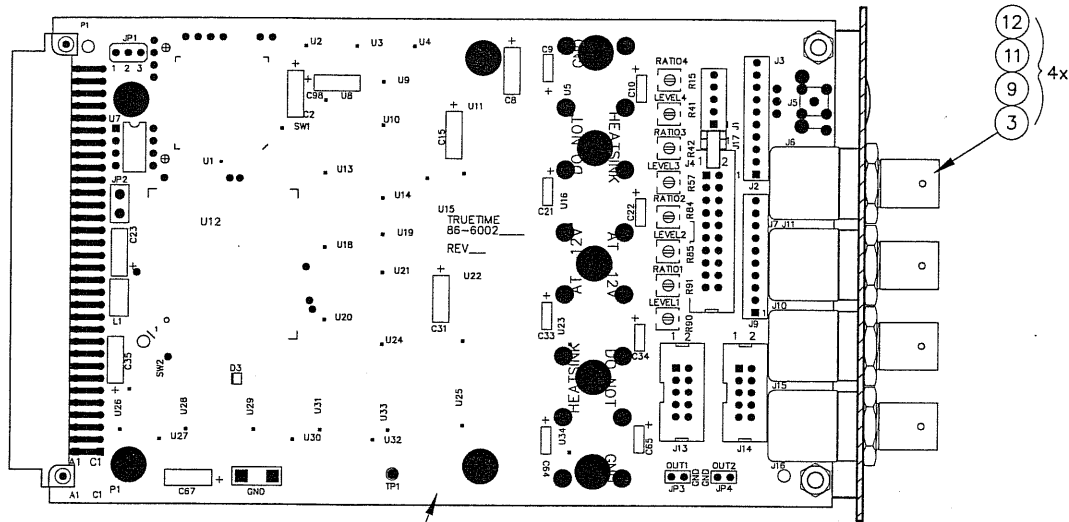
© TrueTime, Inc

PROPRIETARY NOTICE

THIS DOCUMENT, WHETHER PATENTABLE OR NON-PATENTABLE SUBJECT MATTER, EMBODIES PROPRIETARY AND CONFIDENTIAL INFORMATION AND IS THE EXCLUSIVE PROPERTY OF TRUETIME, INC. IT MAY NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS FOR ANY PURPOSE EXCEPT THAT FOR WHICH IT IS LOANED, AND IT SHALL BE RETURNED UPON DEMAND.

REVISIONS

REV	DESCRIPTION	DATE	APPROVED
A	CAR 1323	01/27/99	<i>DLA</i>



1 LABEL REAR PANEL AS SHOWN.
NOTES: UNLESS OTHERWISE SPECIFIED.

DETAIL-A
INSIDE OF PANEL
SOLDER LUG MUST BE ANGLED AS SHOWN (4x).

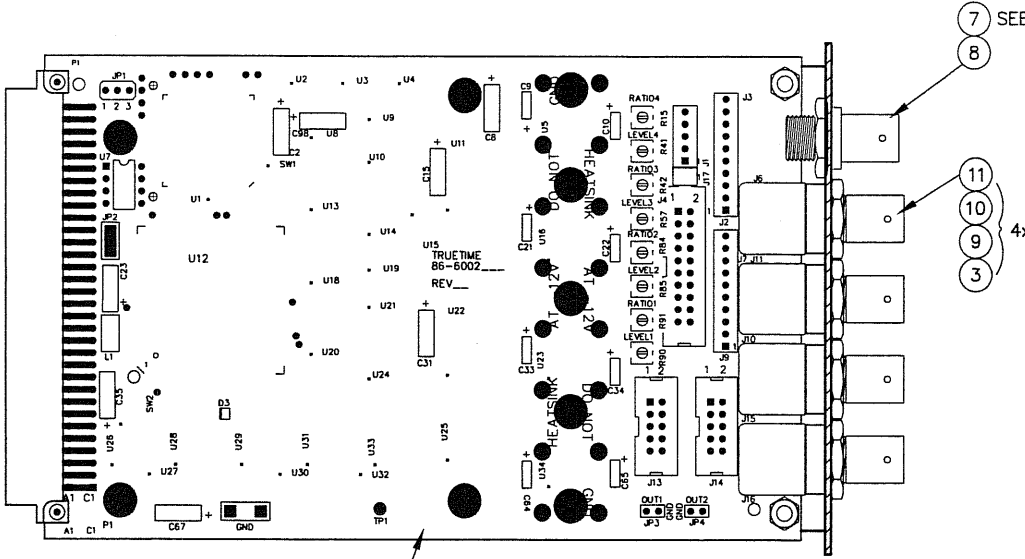
FILENAME: \87\6002-XL6
DATE: 01-27-99

CONTRACT NO.		<p>Where Customer Satisfaction is our Highest Priority 2835 Duke Ct. Santa Rosa, CA 95407</p>		REV	
APPROVALS	DATE			87-6002-XL6 A	
DRAWN BY SEIFERT	4/97			87-6002-XL6 A	
CHECKED BY		SIZE	CODE IDENT NO.	DRAWING NO.	REV
APPROVED BY <i>DLA</i>	2/99	B		87-6002-XL6	A
NEXT ASSY		SCALE NONE	SHEET 1 OF 1		

PROPRIETARY NOTICE

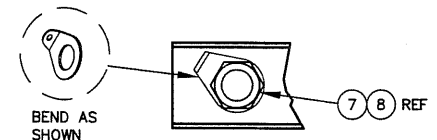
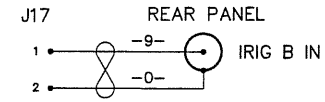
THIS DOCUMENT, WHETHER PATENTABLE OR NON-PATENTABLE SUBJECT MATTER, EMBODIES PROPRIETARY AND CONFIDENTIAL INFORMATION AND IS THE EXCLUSIVE PROPERTY OF TRUETIME, INC. IT MAY NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS FOR ANY PURPOSE EXCEPT THAT FOR WHICH IT IS LOANED, AND IT SHALL BE RETURNED UPON DEMAND.

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
B	ECO 1593	07-10-01	DGK
C	NCR 12932	05-02-02	<i>[Signature]</i>

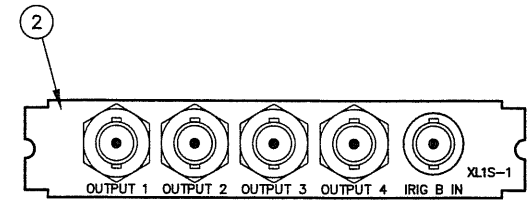
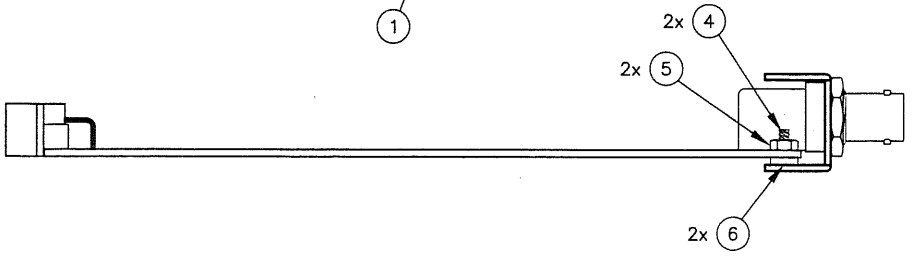


7 SEE DETAIL-A

11
10
9
3 4x



DETAIL-A
INSIDE OF PANEL
SOLDER LUG MUST BE ANGLED AS SHOWN.



1. PLACE 30 GAUGE BUSS WIRE ACROSS JP2.
NOTES: UNLESS OTHERWISE SPECIFIED:

FILENAME: 87-6002-XL1S-1A
DATE: 05-02-02

CONTRACT NO.			APPROVALS		DATE
DRAWN BY JMS			9/15/00		
CHECKED BY					
APPROVED BY DR			9/15/00		
NEXT ASSY		SIZE B	CODE IDENT NO.	DRAWING NO. 87-6002-XL1S-1	REV C
		SCALE NONE	SHEET 1 OF 1		

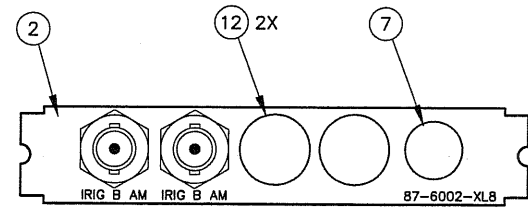
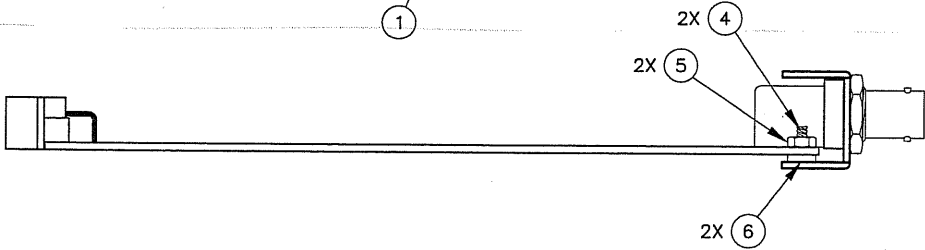
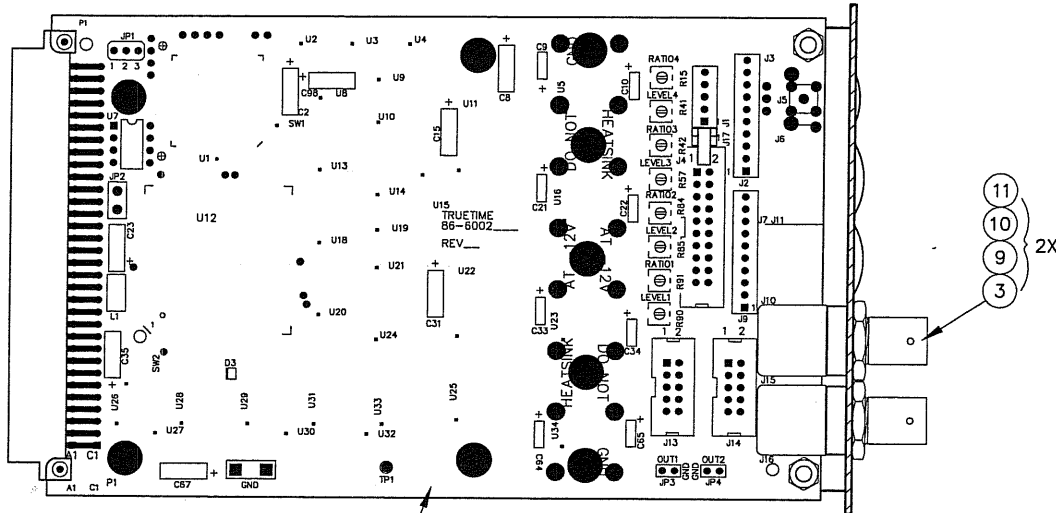
© TrueTime, Inc

PROPRIETARY NOTICE

THIS DOCUMENT, WHETHER PATENTABLE OR NON-PATENTABLE SUBJECT MATTER, EMBODIES PROPRIETARY AND CONFIDENTIAL INFORMATION AND IS THE EXCLUSIVE PROPERTY OF TRUETIME, INC. IT MAY NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS FOR ANY PURPOSE EXCEPT THAT FOR WHICH IT IS LOANED, AND IT SHALL BE RETURNED UPON DEMAND.

REVISIONS

REV	DESCRIPTION	DATE	APPROVED
A	CAR 413; CHG HOLE PLUGS	8-11-97	DL [Signature]



<p>UNLESS OTHERWISE SPECIFIED</p> <p>DIMENSIONS ARE IN INCHES</p> <p>TOLERANCES ARE:</p> <p>FRACTIONS DECIMALS ANGLES</p> <p>± ±.01 ± 2°</p> <p> .XXX±.005</p> <p>ALL THREADS TO BE CLASS 2 PER ANSI Y14-6</p> <p>MACH COR-.005 TO .015R OR CHAM</p> <p>SH MATL-DEBURR & BREAK EDGES .015 MAX R</p> <p>DIM. AND TOL. APPLY FIN. TREAT.</p> <p>MATERIAL</p> <p>FINISH</p> <p>FILENAME: \87\6002-XL8</p> <p>DATE: 8-11-97</p>	CONTRACT NO.		<p>TrueTime</p> <p>2835 DUKE CT. SANTA ROSA CA 95407</p> <p>ASSEMBLY, XL</p> <p>2 IRIG B AM</p>		REV
	APPROVALS	DATE			
	DRAWN BY RKLEIN	6/97	B	87-6002-XL8	A
	CHECKED BY	APPROVED BY [Signature] 8/97			

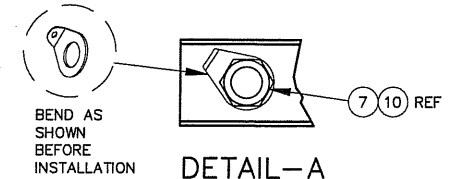
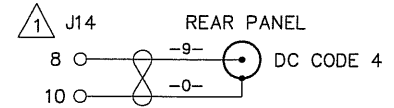
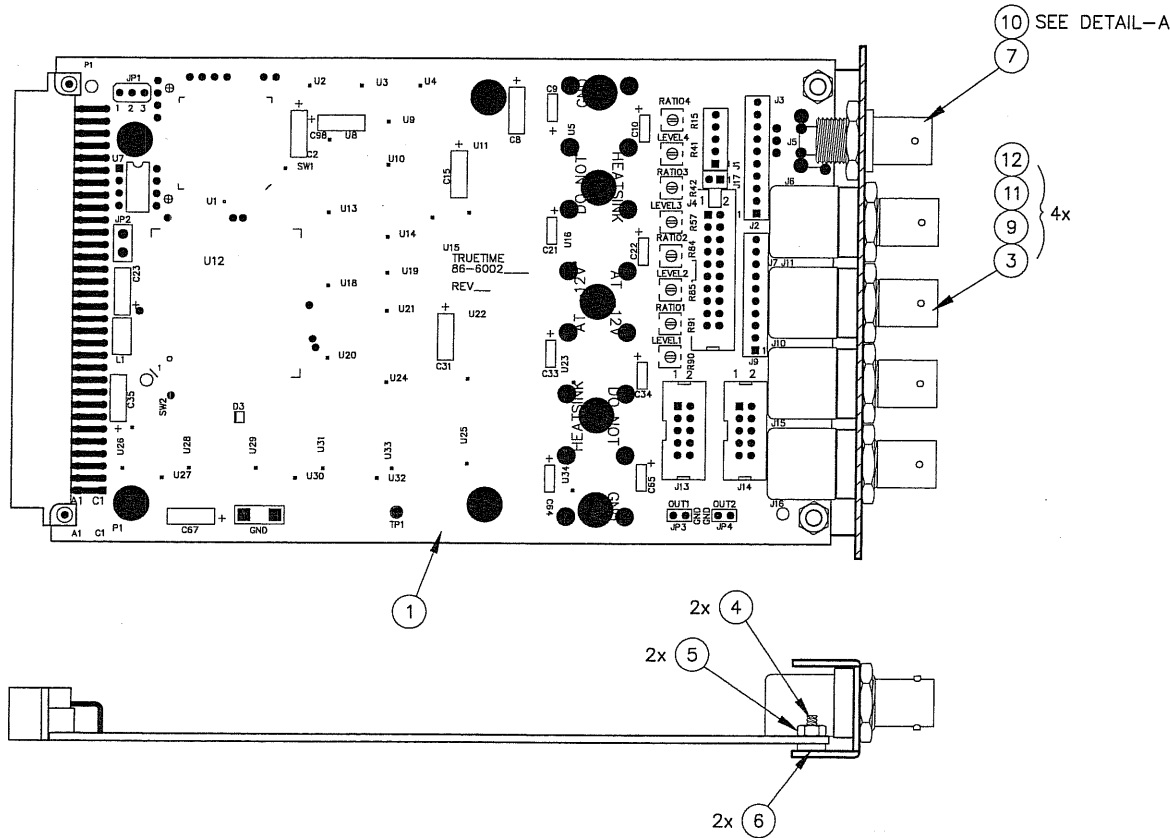
© TrueTime, Inc. 1998 All Rights Reserved.

PROPRIETARY NOTICE

THIS DOCUMENT, WHETHER PATENTABLE OR NON-PATENTABLE SUBJECT MATTER, EMBODIES PROPRIETARY AND CONFIDENTIAL INFORMATION AND IS THE EXCLUSIVE PROPERTY OF TRUETIME, INC. IT MAY NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS FOR ANY PURPOSE EXCEPT THAT FOR WHICH IT IS LOANED, AND IT SHALL BE RETURNED UPON DEMAND.

REVISIONS

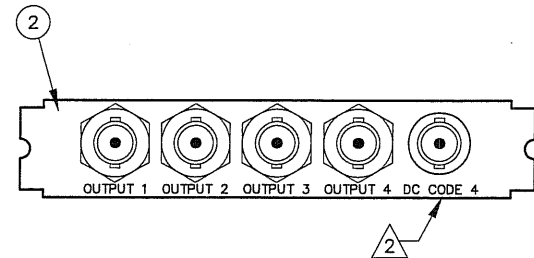
REV	DESCRIPTION	DATE	APPROVED
A	CAR 413	09/17/98	



BEND AS SHOWN BEFORE INSTALLATION

DETAIL-A
INSIDE OF PANEL

SOLDER LUG MUST BE ANGLED AS SHOWN (6X).



2 LABEL PANEL AS SHOWN.

1 SOLDER WIRES DIRECTLY TO PCB.

NOTES: UNLESS OTHERWISE SPECIFIED.

FILENAME: \87\6002-XL3
DATE: 09-17-98

CONTRACT NO.		 <small>"Where Customer Satisfaction is our Highest Priority"</small> 2835 Duke Ct. Santa Rosa, CA 95407					
APPROVALS	DATE					ASSEMBLY, XL 4AM OUT, 1DC OUT	
DRAWN BY SEIFERT	8/96						
CHECKED BY							
APPROVED BY <i>DACA</i>	9/98	DRAWING NO.		REV			
NEXT ASSY		B	87-6002-XL3	A			
SCALE NONE		SHEET 1 OF 1					

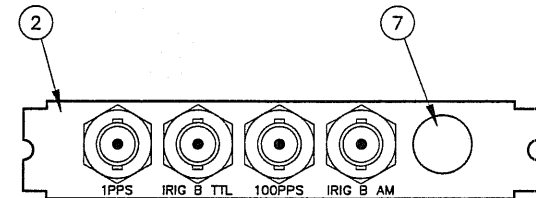
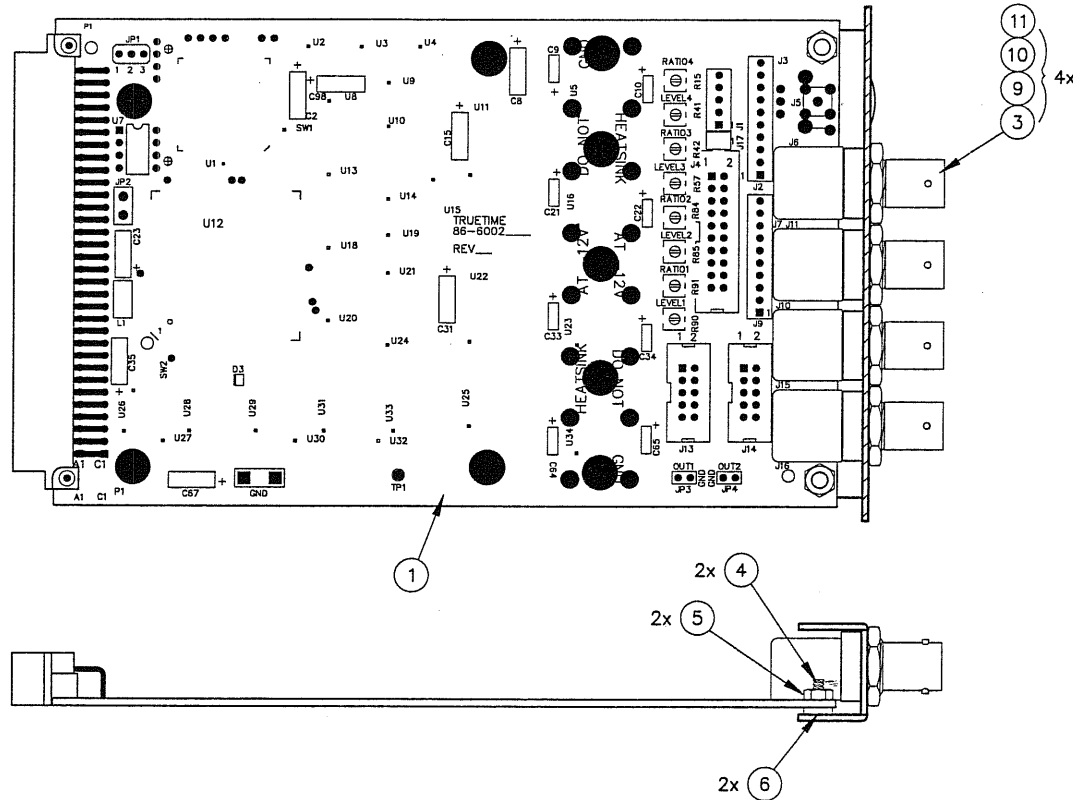
© TrueTime, Inc. 1999 All Rights Reserved.

PROPRIETARY NOTICE

THIS DOCUMENT, WHETHER PATENTABLE OR NON-PATENTABLE SUBJECT MATTER, EMBODIES PROPRIETARY AND CONFIDENTIAL INFORMATION AND IS THE EXCLUSIVE PROPERTY OF TRUETIME, INC. IT MAY NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS FOR ANY PURPOSE EXCEPT THAT FOR WHICH IT IS LOANED, AND IT SHALL BE RETURNED UPON DEMAND.

REVISIONS

REV	DESCRIPTION	DATE	APPROVED



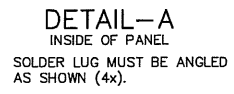
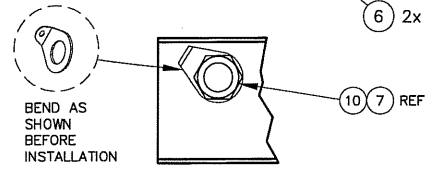
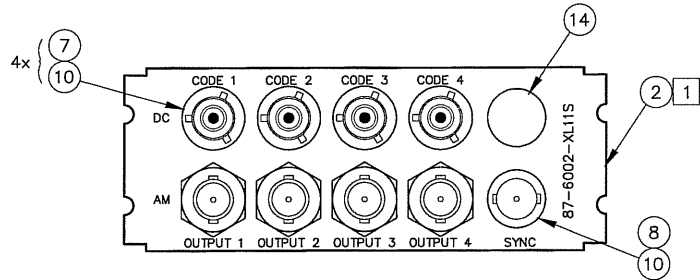
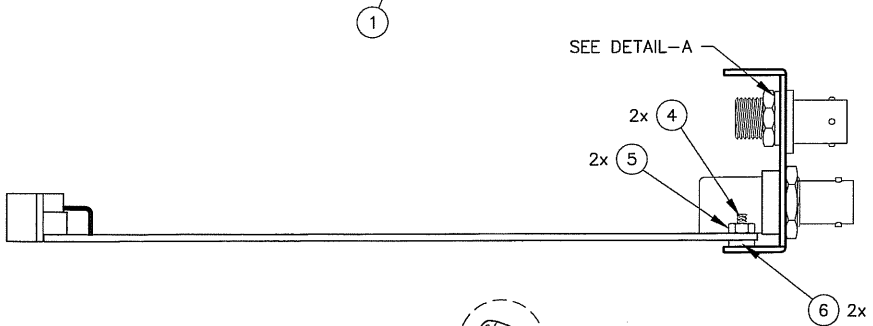
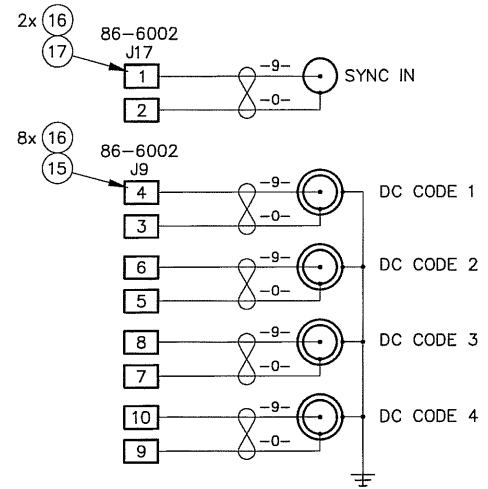
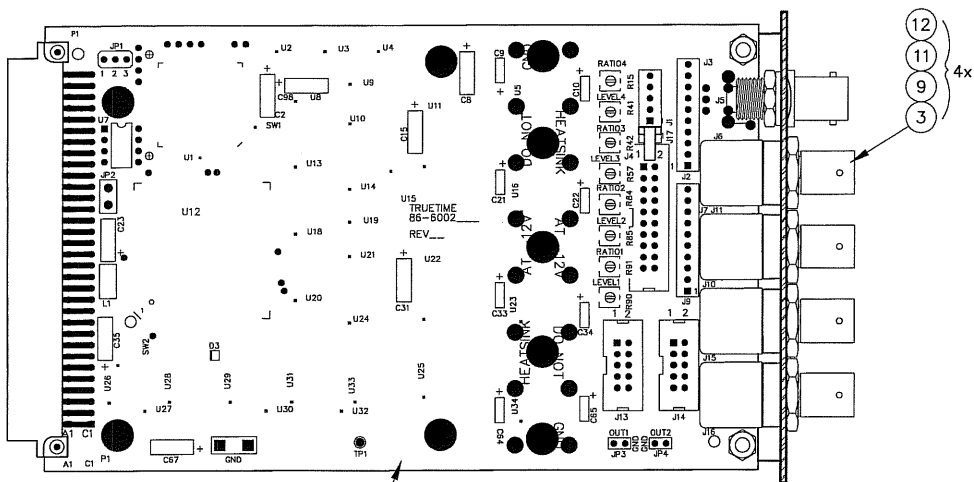
1. LABEL PANEL AS SHOWN.
 NOTES: UNLESS OTHERWISE SPECIFIED.

FILENAME: \87\6002XL10
 DATE: 01-12-99

CONTRACT NO.		 <small>"Where Customer Satisfaction is our Highest Priority" 2835 Duke Ct. Santa Rosa, CA 95407</small>		
APPROVALS	DATE			
DRAWN BY RNR	01/99	ASSEMBLY, XL 3TTL/1AM OUTPUTS		
CHECKED BY				
APPROVED BY <i>Dga</i>	1-99			
NEXT ASSY	SIZE B	CODE IDENT NO.	DRAWING NO. 87-6002-XL10	REV N/C
	SCALE NONE			SHEET 1 OF 1

© TrueTime, Inc. 2001 All Rights Reserved.
 PROPRIETARY NOTICE
 THIS DOCUMENT, WHETHER PATENTABLE OR NON-PATENTABLE SUBJECT MATTER, EMBODIES PROPRIETARY AND CONFIDENTIAL INFORMATION AND IS THE EXCLUSIVE PROPERTY OF TRUETIME, INC. IT MAY NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS FOR ANY PURPOSE EXCEPT THAT FOR WHICH IT IS LOANED, AND IT SHALL BE RETURNED UPON DEMAND.

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



1 LABEL REAR PANEL AS SHOWN.
 NOTES: UNLESS OTHERWISE SPECIFIED.

CONTRACT NO.	
APPROVALS	DATE
DRAWN BY RNR	08/01
CHECKED BY <i>dlg</i>	09/01
APPROVED BY <i>Sgt</i>	09/01
NEXT ASSY	

TRUETIME

ASSEMBLY, XL
 SYNC, 4AM, 4DC OUT

SIZE	CODE IDENT NO.	DRAWING NO.	REV
B		87-6002-XL11S	A
SCALE NONE		SHEET 1 OF 1	

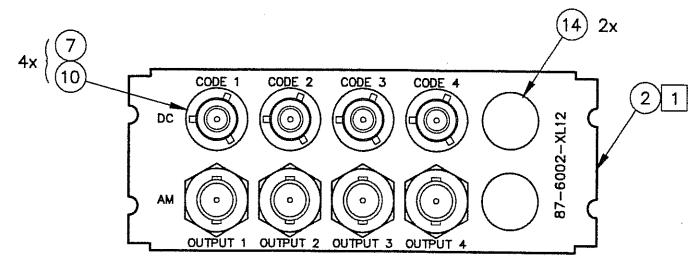
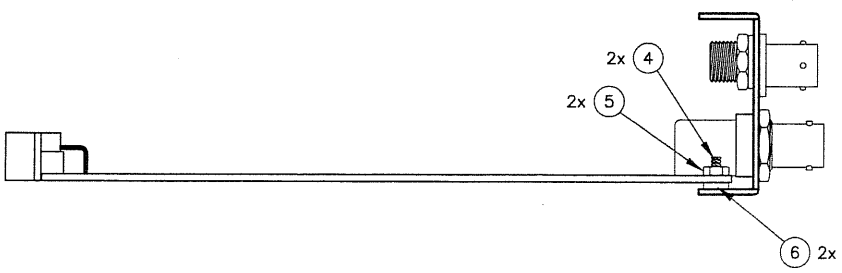
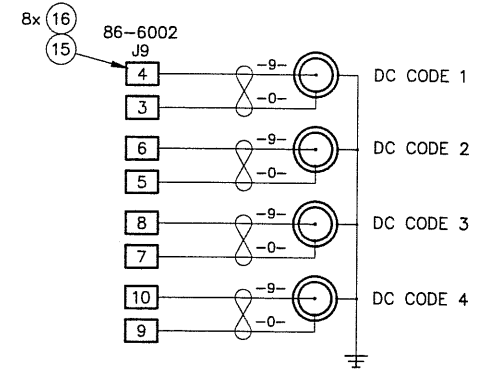
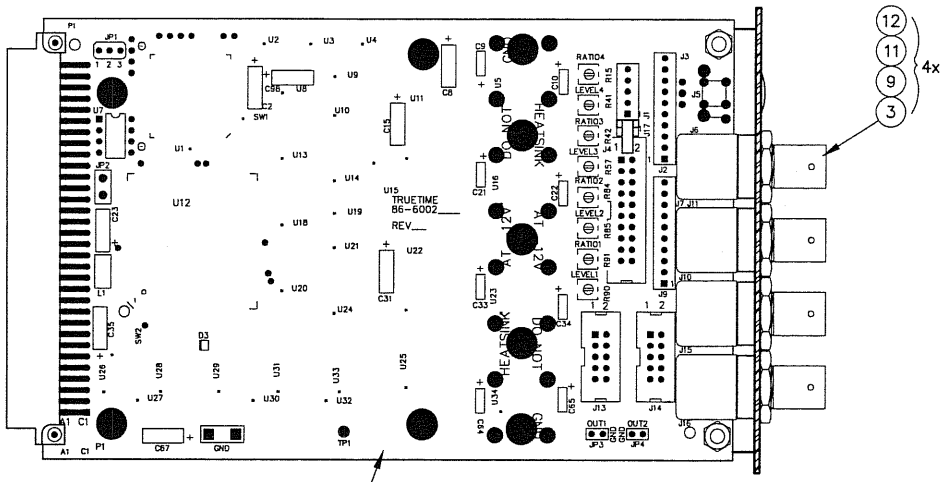
FILENAME: \87\87-6002XL11S
 DATE: 09-05-01

© TrueTime, Inc. 2002 All Rights Reserved.

PROPRIETARY NOTICE

THIS DOCUMENT, WHETHER PATENTABLE OR NON-PATENTABLE SUBJECT MATTER, EMBODIES PROPRIETARY AND CONFIDENTIAL INFORMATION AND IS THE EXCLUSIVE PROPERTY OF TRUETIME, INC. IT MAY NOT BE REPRODUCED, USED OR DISCLOSED TO OTHERS FOR ANY PURPOSE EXCEPT THAT FOR WHICH IT IS LOANED, AND IT SHALL BE RETURNED UPON DEMAND.

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



1 LABEL REAR PANEL AS SHOWN.
 NOTES: UNLESS OTHERWISE SPECIFIED.

FILENAME: 87-6002XL12
 DATE: 07-19-02

CONTRACT NO.				
APPROVALS	DATE			
DRAWN BY RNR	07/02			
CHECKED BY				
APPROVED BY <i>JETA</i>	7/22/02			
NEXT ASSY	SIZE B	CODE IDENT NO.	DRAWING NO. 87-6002-XL12	REV A
SCALE NONE		SHEET 1 OF 1		